Optical Design and Analysis Techniques for FIR/submm Imaging and Spectrometry

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The need for wide-field imaging at diffraction-limited spatial resolution can force the design of astronomical FIR/submm instruments to grow in size beyond the requirements of a space instrument. The use of shaped elements, based on extended aspheric surfaces, can allow more degrees of freedom in compact systems with a reduced number of optical elements. The ray-tracing-based design is then complemented by targeted diffraction methods chosen on the basis of the performances to assess (in-field spatial response or out-of-field stray light rejection). Associated experimental verification of the performances during ground-testing can make use of standard intensity and beam pattern measurements for modal reconstruction and optical system-level characterization. These approaches are illustrated by examples of applications for different FIR/submm systems. Instruments are also often required to merge the imaging and spectroscopic functionalities. Review of current imaging spectrometer types show that instrument needs are in general well-addressed by imaging FTS. For medium and/or high spectral resolution, a FP-FTS cascade imaging spectrometer is presented and compared to more compact dispersed FTS design with no moving parts. Finally long-wavelength effect limiting fringe visibility and effective spectral resolution in such compact interferometric systems is briefly discussed.

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